Commercializing New NO_x Reduction Technology

ENERGY EFFICIENCY AND RENEWABLE ENERGY

OFFICE OF TRANSPORTATION TECHNOLOGIES

Transportation

FOR THE 21ST CENTURY

Background

Emissions of oxides of nitrogen (NO_x) from fossil fuel-fired electric utilities, heavy vehicles and buses, automobiles, and other industrial, commercial, and residential combustion sources can lead to environmental and health hazards, such as acid rain and respiratory disease. A process developed at Sandia National Laboratories (SNL) in the mid-1980s is the basis for a new, onboard exhaust treatment system that can help America's truck and bus fleets reduce their emissions of NO_x by up to 90% or more, while simultaneously eliminating up to 80% of the small lung-burning particulates endemic to diesel exhaust.

The Technology

Challenged by the U.S. Department of Energy to develop a way to rapidly reduce NO_x emissions in diesel exhaust, a team at SNL and Technor, Inc. developed the RAPRENOX process. The basic concept behind the patented technology is to inject nontoxic cyanuric acid into the exhaust and drive a reaction that breaks NO_x down into benign constituent elements by use of high temperature rather than a chemical catalyst. The technology was transferred to Cummins Engine Company where years of cutting-edge research and development to commercialize the process was performed. Recently, Cummins management and members of the development team bought the rights to the evolving process and formed a company called Noxtech, Inc. Noxtech, Inc. is modifying the original RAPRENOX process to increase the effectiveness of NO_x conversion and reduce cost.

The R&D work transforming the original RAPRENOX process into the advanced NOXTECH system is focused on two key areas: reducing chemical costs and reducing the size and power drain of the reactor needed to achieve the required temperature. This system utilizes a small reactor about the size of a muffler capable of sustaining a temperature of 1400°F. In addition to removing most of the NO_x efficiently, the reaction also burns off most of the hydrocarbons and diesel particulates, often eliminating the need for a stand-alone particulate trap or other emission reduction device. Noxtech's substitution of an inexpensive, nontoxic liquid chemical, urea, to replace the more expensive powdered cyanuric acid used in the original RAPRENOX process has resulted in lower raw material costs (from $0.55/pound to $0.12/pound). System simplifications reduced total system costs from $150/kW to $50/kW, making the system even more practical for commercial use.

Commercialization

Noxtech, Inc. has installed its advanced NOXTECH system at several power generation facilities for Southern California Edison. One of the systems was installed on a 2.5-mega-watt (MW) and a 3.8-MW diesel electric generator that supply prime power to Catalina island. Since 1995, this system has reliably reduced NO_x by as much as 98%, exceeding the 95% guarantee provided to Southern California Edison. Noxtech anticipates producing prototypes to meet the needs of heavy-duty diesel engines for transportation applications by 2001, with commercialization possible by 2003. Due to recent Environmental Protection Agency regulations, Noxtech is currently pursuing multi-billion dollar markets that will require NO_x reduction equipment for stationary diesel engines, as well as utility, industrial, and waste-to-energy boilers.

Benefits

- **Reduces emissions of NO_x by 90%**
- **Reduces emissions of NMOG, particulates, and carbon monoxide by 80%**
- **Reduces costs by 50% compared to the leading NO_x reduction systems used by utilities**

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